IN THE UNITED STATES PATENT AND TRADEMARK OFFICE
BEFORE THE BOARD OF PATENT APPEALS AND INTERFERENCES

APPEAL BRIEF FOR THE APPELLANT

Ex parte SALONIDIS *et al.*

DISTRIBUTED BANDWIDTH ALLOCATION AND TRANSMISSION COORDINATION METHOD FOR QUALITY OF SERVICE PROVISION IN WIRELESS AD HOC NETWORKS

Serial No. 10/736,909
Confirmation No. 4027
Appeal No.:
Group Art Unit: 2473

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In re the Appellant:

Theodoros SALONIDIS et al. — Appeal No.:

Serial Number: 10/736,909 — Group Art Unit: 2473

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Confirmation No. 4027

For: DISTRIBUTED BANDWIDTH ALLOCATION AND TRANSMISSION COORDINATION METHOD FOR QUALITY OF SERVICE PROVISION IN WIRELESS AD HOC NETWORKS

BRIEF ON APPEAL

November 9, 2010

This is an appeal from the final rejection set forth in an Official Action dated August 11, 2010, finally rejecting claims 1-8, all of the claims pending in this application as being unpatentable over Hammel (U.S. Patent No. 7,283,494), Cousins (U.S. Patent No. 6,618,385), Fenton (U.S. Patent Publication No. 2003/0109253), and Counterman (U.S. Patent No. 6,724,727). After a lengthy prosecution that has exceeded six years, and after multiple interviews with the Examiner of record, this Appeal Brief is being timely filed.

I. REAL PARTY IN INTEREST

The real party in interest in this application is the University of Maryland of College Park, Maryland, by virtue of an Assignment by the inventors, which assignment was

recorded at Reel 015276, Frame 0036, on April 28, 2004.

II. RELATED APPEALS AND INTERFERENCES

There are no known related appeals and/or interferences which will directly effect or be directly effected by or have a bearing on the Board's decision in this appeal.

III. STATUS OF CLAIMS

Claims 1-8, all of the claims pending in the present application, are the subject of this appeal. Claims 1-2 and 4-8 were rejected under 35 U.S.C. § 103(a) as being unpatentable over Hammel, in view of Cousins, and further in view of Fenton. Claim 3 was rejected under 35 U.S.C. § 103(a) as being unpatentable over Hammel, in view of Cousins, in view of Fenton, and further in view of Counterman.

IV. STATUS OF AMENDMENTS

All of claims 1-8 stand as they were previously presented prior to the Final Office Action. No amendments were made after the final rejection. Thus, claims 1-8 are pending, and the rejections of claims 1-8 are appealed.

V. SUMMARY OF CLAIMED SUBJECT MATTER

Claim 1, upon which claims 2-5 are dependent, recites a method of allocating bandwidth in a first node that is operable in an ad hoc, wireless network configured to support at least one guaranteed feasible flow allocation (Specification, at least at page 25, lines 16-20; Fig. 8 ("representative method 800")). The method includes the steps of

initiating a communication between the first node and a second node in the network that, together, are endpoints of a link, the communication being related to possible bandwidth allocation adjustment of a flow sharing the link (Specification, at least at page 25, lines 20-23; Fig. 8 (“step 810”)), and determining, in the first node, a first new bandwidth allocation that approaches a first optimization condition for the flow (Specification, at least at page 25, lines 23-25; Fig. 8 (“step 820”)). The method further includes the steps of communicating with the second node to determine a mutually-agreed upon optimal bandwidth allocation for the flow (Specification, at least at page 25, lines 25-27; Fig. 8 (“step 830”)), and notifying neighbor nodes in the network of the mutually-agreed upon optimal bandwidth allocation when reallocation is needed, where the neighbor nodes each modify their bandwidth allocation based on the notification (Specification, at least at page 25, lines 27-29, and page 14, line 12 – page 17, line 1; Fig. 8 (“step 840”)). The method further includes the step of adopting the mutually-agreed upon optimal allocation for the flow when reallocation is needed (Specification, at least at page 25, line 29 – page 26, line 1; Fig. 8 (“step 850”)). The at least one guaranteed feasible flow allocation includes at least one flow allocation for which a schedule exists that can realize the at least one flow allocation by taking into account flows in the ad hoc network (Specification, at least at page 18, lines 10-18).

Claim 6 recites a network device configured to allocate bandwidth in an ad hoc, wireless network configured to support at least one guaranteed feasible flow allocation (Specification, at least at page 26, lines 15-17; Fig. 9 (“representative network device 900”), (“ad hoc wireless network 910”)). The network device includes a first communication unit configured to initiate a communication between the device and a

node in the network that, together, are endpoints of a link in the network, the communication being related to possible bandwidth allocation adjustment of a flow sharing the link (Specification, at least at page 26, lines 18-22; Fig. 9 (“first communication unit 930”), (“representative network device 900”), (“node 905”), (“network 910”), (“flow sharing link 915”)). The network device further includes a first processing unit configured to determine a first new bandwidth allocation that approaches a first optimization condition for the flow, where the first processing unit is operably connected to the first communication unit (Specification, at least at page 26, lines 22-25; Fig. 9 (“first processing unit 950”), (“flow sharing link 915”), (“first communication unit 930”)). The network device further includes a second communication unit configured to communicate with the node to determine a mutually-agreed upon optimal bandwidth allocation for the flow, where the second communication unit is operably connected to the first communication unit (Specification, at least at page 26, lines 25-29; Fig. 9 (“second communication unit 940”), (“node 905”), (“first communication unit 930”)). The network device further includes a third communication unit configured to notify neighbor nodes in the network of the mutually-agreed upon optimal bandwidth allocation when reallocation is needed, where the neighbor nodes each modify their bandwidth allocation based on the notification, where the third communication unit is operably connected to the first communication unit (Specification, at least at page 26, line 29 – page 27, line 4, and page 14, line 12 – page 17, line 1; Fig. 9 (“third communication unit 920”), (“network 910”), (“first communication unit 930”)). The network device further includes a second processing unit configured to adopt the mutually-agreed upon optimal allocation for the flow when reallocation is needed, where the second processing unit is operably connected to the

first communication unit (Specification, at least at page 27, lines 4-7; Fig. 9 ("second processing unit 960"), ("first communication unit 930")). The at least one guaranteed feasible flow allocation includes at least one flow allocation for which a schedule exists that can realize the at least one flow allocation by taking into account flows in the ad hoc network (Specification, at least at page 18, lines 10-18).

Claim 7 recites a computer program embodied on a computer readable medium to allocate bandwidth in an ad hoc, wireless network configured to support at least one guaranteed feasible flow allocation (Specification, at least at page 27, lines 8-13; Fig. 10 ("flowchart 1000")). The computer program is configured to control a processor to perform a first sub-routine for initiating a communication between the first node and a second node in the network that, together, are endpoints of a link, the communication being related to possible bandwidth allocation adjustment of a flow sharing the link (Specification, at least at page 27, lines 13-17; Fig. 10 ("first sub-routine 1010")), and a second sub-routine for determining, in the first node, a first new bandwidth allocation that approaches a first optimization condition for the flow (Specification, at least at page 27, lines 17-19; Fig. 10 ("second sub-routine 1020")). The computer program is configured to control the processor to perform a third sub-routine for communicating with the second node to determine a mutually-agreed upon optimal bandwidth allocation for the flow (Specification, at least at page 27, lines 19-21; Fig. 10 ("third sub-routine 1030")), and a fourth sub-routine for notifying neighbor nodes in the network of the mutually-agreed upon optimal bandwidth allocation when reallocation is needed, where the neighbor nodes each modify their bandwidth allocation based on the notification (Specification, at least at page 27, lines 21-23, and page 14, line 12 – page 17, line 1; Fig. 10 ("fourth sub-routine

1040”)). The computer program is configured to control the processor to perform a fifth sub-routine for adopting the mutually-agreed upon optimal allocation for the flow when reallocation is needed (Specification, at least at page 27, lines 24-26; Fig. 10 (“fifth sub-routine 1050”)). The at least one guaranteed feasible flow allocation includes at least one flow allocation for which a schedule exists that can realize the at least one flow allocation by taking into account flows in the ad hoc network (Specification, at least at page 18, lines 10-18).

Claim 8 recites a network device configured to allocate bandwidth in an ad hoc, wireless network configured to support at least one guaranteed feasible flow allocation (Specification, at least at page 26, lines 15-17; Fig. 9 (“representative network device 900”), (“ad hoc wireless network 910”)). The network device includes initiation means for initiating a communication between the first node and a second node in the network that, together, are endpoints of a link, the communication being related to possible bandwidth allocation adjustment of a flow sharing the link (Specification, at least at page 26, lines 18-22; Fig. 9 (“first communication unit 930”), (“representative network device 900”), (“node 905”), (“network 910”), (“flow sharing link 915”)). The network device further includes determination means for determining, in the first node, a first new bandwidth allocation that approaches a first optimization condition for the flow (Specification, at least at page 26, lines 22-25; Fig. 9 (“first processing unit 950”), (“flow sharing link 915”)). The network device further includes determination means for communicating with the second node to determine a mutually-agreed upon optimal bandwidth allocation for the flow (Specification, at least at page 26, lines 25-29; Fig. 9 (“second communication unit 940”), (“node 905”)). The network device further includes notification means for notifying

neighbor nodes in the network of the mutually-agreed upon optimal bandwidth allocation when reallocation is needed, where the neighbor nodes each modify their bandwidth allocation based on the notification (Specification, at least at page 26, line 29 – page 27, line 4, and page 14, line 12 – page 17, line 1; Fig. 9 ("third communication unit 920")). The network device further includes adoption means for adopting the mutually-agreed upon optimal allocation for the flow when reallocation is needed (Specification, at least at page 27, lines 4-7; Fig. 9, ("second processing unit 960")). The at least one guaranteed feasible flow allocation includes at least one flow allocation for which a schedule exists that can realize the at least one flow allocation by taking into account flows in the ad hoc network (Specification, at least at page 18, lines 10-18).

VI. GROUNDS OF REJECTION TO BE REVIEWED ON APPEAL

The grounds of rejection to be reviewed on appeal are the rejection of claims 1-2 and 4-8 under 35 U.S.C. § 103(a) as allegedly being unpatentable over Hammel, in view of Cousins, and further in view of Fenton, and the rejection of claim 3 under 35 U.S.C. § 103(a) as allegedly being unpatentable over Hammel, in view of Cousins, in view of Fenton, and further in view of Counterman. As will be discussed below, these rejections are in error, and claims 1-8 should all be found to meet the U.S. requirements for patentability under 35 U.S.C. § 103.

VII. ARGUMENT

Appellants respectfully submit that each of the pending claims 1-8 recites patentable subject matter that is not taught, disclosed, or suggested by the cited art.

Each of the claims is being argued separately, and thus, each of the claims stands or falls alone.

As reiterated by the Supreme Court in *KSR International Co. v. Teleflex Inc.*, 550 U.S. 398, 82 USPQ2d 1385 (2007), the framework for an objective analysis for determining obviousness under 35 U.S.C. § 103 is stated in *Graham v. John Deere Co.*, 383 U.S. 1, 148 USPQ 459 (1966). Obviousness is a question of law based on underlying factual inquiries. The factual inquiries are: (a) determining the scope and content of the prior art; (b) ascertaining the differences between the claimed invention and the prior art; and (c) resolving the level of ordinary skill in the pertinent art. *See KSR International Co. v. Teleflex Inc.*, 550 U.S. 398, 82 USPQ2d 1385 (2007); *Graham v. John Deere Co.*, 383 U.S. 1, 148 USPQ 459 (1966); *see also* MPEP § 2141. The Supreme Court in *KSR* also noted that the analysis supporting a rejection under 35 U.S.C. § 103 should be made explicit. The court stated that "rejections on obviousness cannot be sustained by mere conclusory statements; instead there must be some articulated reasoning with some rational underpinning to support the legal conclusion of obviousness." *See KSR*, 550 U.S. at 398, 82 UPSQ2d at 1396; *see also* MPEP § 2141.

Within this obviousness framework, the Federal Circuit has further stated that it is impermissible to use an applicant's claimed invention as an instruction manual or "template" to piece together several teachings of the prior art so that the claimed invention is rendered obvious. *See In re Fitch*, 972 F.2d 1260, 1265, 23 USPQ2d 1780, 1784 (Fed. Cir. 1992); *see also In re Gorman*, 933 F.2d 982, 987, 18 USPQ2d 1885, 1888 (Fed. Cir. 1991), *Interconnect Planning Corp. v. Feil*, 774 F.2d 1132, 1138, 227 USPQ 543, 547 (Fed. Cir. 1985). Furthermore, an Examiner cannot use hindsight reconstruction to pick

and chose among several isolated disclosures in the prior art to deprecate the claimed invention. *See In re Fitch*, 972 F.2d at 1265, 23 USPQ2d at 1784; *see also In re Fine*, 837 F.2d 1071, 1075, 5 USPQ2d 1596, 1600 (Fed. Cir. 1988).

A. Claims 1-2 and 4-8 are not obvious in view of Hammel, Cousins, and Fenton

In the Final Office Action, claims 1-2 and 4-8 were rejected under 35 U.S.C. § 103(a) as being unpatentable over Hammel, Cousins, and Fenton. Appellants submit that each of claims 1-2 and 4-8 recite subject matter that is not obvious in light of Hammel, Cousins, and Fenton, and as such, the Board's reversal of the rejection is respectfully requested.

i) Claim 1

Claim 1, upon which claims 2-5 are dependent, recites a method of allocating bandwidth in a first node that is operable in an ad hoc, wireless network configured to support at least one guaranteed feasible flow allocation. The method includes the steps of initiating a communication between the first node and a second node in the network that, together, are endpoints of a link, the communication being related to possible bandwidth allocation adjustment of a flow sharing the link, and determining, in the first node, a first new bandwidth allocation that approaches a first optimization condition for the flow. The method further includes the steps of communicating with the second node to determine a mutually-agreed upon optimal bandwidth allocation for the flow, and notifying neighbor nodes in the network of the mutually-agreed upon optimal bandwidth allocation when reallocation is needed, where the neighbor nodes each modify their

bandwidth allocation based on the notification. The method further includes the step of adopting the mutually-agreed upon optimal allocation for the flow when reallocation is needed. The at least one guaranteed feasible flow allocation includes at least one flow allocation for which a schedule exists that can realize the at least one flow allocation by taking into account flows in the ad hoc network.

As will be discussed below in greater detail, Hammel, Cousins, and Fenton, whether considered individually or in combination, fail to disclose or suggest, at least, "notifying neighbor nodes in the network of the mutually-agreed upon optimal bandwidth allocation when reallocation is needed, wherein the neighbor nodes each modify their bandwidth allocation based on the notification," and "wherein the at least one guaranteed feasible flow allocation comprises at least one flow allocation for which a schedule exists that can realize the at least one flow allocation by taking into account flows in the ad hoc network," as recited in claim 1. Furthermore, Appellants respectfully submit that if the Board finds that the combination of Hammel, Cousins, and Fenton, fails to disclose or suggest any one of the aforementioned limitations, the Board should reverse the rejection, as the Final Office Action has failed to establish that claim 1 would be obvious to one of ordinary skill in the art, in light of the clear differences of claim 1 and the combination of Hammel, Cousins, and Fenton.

Hammel describes a distributed, locally determined, channel access protocol that adapts to load, avoids interference and controls access by a group of nodes to a set of shared channels. Shared channel space is divided into a number of communication slots that are repeated at a predetermined interval. Permission to use a slot to communicate between any two nodes is dynamically adjusted by the channel access protocol, which

locally estimates load to neighboring nodes, allocates or deallocates slot usage to adapt to load and avoid interference, and asserts and advertises slot usage within an interference area about itself (see Hammel at Abstract).

Appellants respectfully submit that Hammel fails to disclose or suggest "notifying neighbor nodes in the network of the mutually-agreed upon optimal bandwidth allocation when reallocation is needed, wherein the neighbor nodes each modify their bandwidth allocation based on the notification," as recited in claim 1. Hammel describes a wireless mesh network. The mesh architecture of the wireless mesh network includes network access concentrators ("SNAPs") 103, network access points ("NAPs") 101, and network access nodes 102. Traffic in network 100 may be routed from a network access node 102 to a neighboring network access node 102. Such a neighboring network access node 102 may route such traffic to one of its neighboring network access nodes 102 and so on until a NAP 101 or a final destination network access node 102 is reached (see Hammel at col. 4, lines 18-30; Figure 1).

Nodes 102, NAPs 101, or a NAP 101 and a node 102, may communicate with each other using point-to-point communication (see Hammel at col. 4, lines 59-62). Specifically, NAPs 101 and nodes 102 communicate with each other by sending and receiving information during short time slots reference to the beginning of a frame (see Hammel at col. 5, lines 7-10). During communication, at a node, a number of communication slots is estimated. The number of communication slots estimated is compared to a number of communication slots currently allocated for communicating with a neighboring node. If the estimated number of slots is less than the currently allocated number of slots, the number of allocated slots is decreased. If the estimated number of

slots equals the currently allocated number of slots, then no change in allocation is made. However, if the estimated number of slots is greater than a number of currently allocated slots for communication, slot allocation can be increased. If there are not a sufficient number of free slots to be allocated, then currently allocated slot usage may be overridden based on priority (see Hammel at col. 9, line 59 – col. 10, line 25).

The Final Office Action took the position that advertising steps 1109 and 1112 of Fig. 11 of Hammel disclose the aforementioned limitation of claim 1. Appellants respectfully submit that this position is incorrect because Hammel fails to disclose or suggest that a node notifies neighboring nodes of a mutually-agreed upon optimal bandwidth allocation.

Specifically, Hammel discloses that when a slot is allocated, all neighboring nodes are informed of the allocation by communication between the nodes (see Hammel at col. 15, lines 4-22). When a neighboring node receives a slot allocation transmission, a determination is made as to whether the slot allocation pertains to the neighboring node. If the slot allocation does not pertain to the neighboring node, but the transmission associated with the slot allocation is within the node's interference area, then the node advertises to all its neighboring nodes whether one or more neighbors of the slot allocation received the transmission (i.e., step 1109 of Fig. 11). If the slot allocation does pertain to the neighboring node, and it is determined that the slot allocation is not acceptable, then the slot allocation is cancelled, and the cancellation is advertised to all neighboring nodes (i.e., step 1112 of Fig. 11) (see Hammel at col. 15, line 34 – col. 16, line 25).

Neither the notification in step 1109, nor the notification in step 1112 can

reasonably be characterized as a notification of a mutually-agreed upon optimal bandwidth allocation. In the case of the notification in step 1109, the notification is merely a notification that the slot allocation is within an interference area of a neighboring node. Furthermore, in the case of the notification in step 1112, the neighboring node unilaterally cancels the slot allocation of the first node. This cancellation is done without any input from the first node. Characterizing this unilateral action as "mutually-agreed upon" is clearly not a reasonable characterization of Hammel, as the first node and the neighboring node do not mutually agree to anything, as tacitly admitted by the Final Office Action (see Final Office Action at page 7, "Hammel does not explicitly indicate that the determined allocation is "mutually-agreed upon…"). In addition, as the Final Office Action correctly concluded, Hammel fails to disclose or suggest that a neighbor node modifies its bandwidth allocation based upon the notification. Thus, Hammel fails to disclose or suggest the aforementioned limitation of claim 1.

With respect to "wherein the at least one guaranteed feasible flow allocation comprises at least one flow allocation for which a schedule exists that can realize the at least one flow allocation by taking into account flows in the ad hoc network," as recited in claim 1, Appellants respectfully submit that Hammel fails to disclose or suggest this limitation as well. As previously discussed, Hammel describes that nodes in a wireless mesh network communicate with each other by sending and receiving information during short time slots reference to the beginning of a frame (see Hammel at col. 5, lines 7-10). Hammel further describes a slot allocation program which first attempts to allocate slots without overriding any existing allocations (see Hammel at col. 10, lines 55-57). However, if there is an insufficient number of time slots available to effectuate a communication

without overriding one or more existing slot allocations, then an override priority is incremented and a node asserting the communication can proceed to cancel another node's slot allocation, and assert its own slot allocation (see Hammel at col. 12, lines 11-25, col. 15, lines 4-12). Thus, the slot allocation program described in Hammel merely prevents two nodes from allocating the same slot by first attempting to schedule slot allocations so that they do not conflict, and then by canceling a slot allocation of lower priority, when an conflict is unavoidable.

The Final Office Action contended that Hammel discloses provide a flow allocation for which a schedule exists that can realize the at least one flow allocation by taking into account flows in the ad hoc network (see e.g., Final Office Action at page 5). Contrary to the Final Office Action's contention, the slot allocation program of Hammel does not provide a flow allocation for which a schedule exists that can realize the at least one flow allocation by taking into account flows in the ad hoc network because the Final Office Action considers a "flow" to be the same as a "slot," when the two are completely different entities. A flow is a logical entity that does not depend on whether a system is slotted or not, while a slot is particular to a physical layer realization. Thus, a flow can exist in a slotted system, but can also exist in a non-slotted system. Furthermore, in slotted systems, a slot can carry one or more flows. Thus, the consideration of whether a slot has previously been allocated is not analogous to taking into account a flow in a network when establishing a flow allocation.

As an example, in Hammel, if there is an insufficient number of time slots available to effectuate a communication without overriding one or more existing slot allocations, the node asserting the communication can proceed to cancel another node's slot allocation,

and assert its own slot allocation (see Hammel at col. 12, lines 11-25, col. 15, lines 4-12). Thus, the system in Hammel does not take into account the other node's communication when effectuating the first node's communication. Instead, the system completely disregards the other node's communication and cancels the other node's communication to make room for the first node's communication. Therefore, Hammel fails to disclose or suggest the aforementioned limitation of claim 1.

Appellants further submit that Cousins does not cure the deficiencies of Hammel. Cousins describes a network initialization process to determine the maximum available data transfer throughput, optimized bandwidth, and optimized transfer conditions in a wired network (see Cousins at col. 3, lines 42-58). Specifically, the network initialization process also negotiates the number of twisted pair wires to use, detects and identifies scrambled wires, determines the compression scheme to use, etc. These parameters are then utilized in a predetermined well known modulation communications technique such as spread spectrum or Quadrature Amplitude Modulation ("QAM") to accordingly adjust the data transfer rate between the two devices. Also, the negotiation session of Cousins seeks to establish the data transfer scheme between the two machines (e.g., how data is transferred over various twisted pair wires) and to determine the best use of the available bandwidth. Accordingly, part of this negotiation includes the selection of compression algorithms for use in the data transfer. Moreover, the negotiation further includes reservation of part of the bandwidth for isocronous data and/or other non-LAN uses such as streaming video (see Cousins at col. 7, lines 40-52).

In the network described in Cousins, before two machines can communicate with each other, network initialization parameters are utilized by interface adapters 200 of a

designated Data Terminal Equipment ("DTE") and Data Communication Equipment ("DCE") in a negotiation session. The negotiation session establishes the data transfer scheme between the two machines and determines the best use of the available bandwidth (see Cousins at col. 7, lines 40-47). However, Cousins is completely silent with respect to notifying neighboring machines about the negotiation session between the two machines, and is completely silent with respect to the neighboring machines modifying their bandwidth allocation based on the notification. According to an embodiment of the invention, a notification step which notifies neighbors of a mutually-agreed upon bandwidth allocation allows the neighboring nodes to adjust their own allocations and local schedules on their flows that may interfere with the mutually-agreed upon bandwidth allocation in order to maintain feasibility of an overall network bandwidth allocation. Such a concern is not discussed in Cousins, as Cousins focuses on a determination of a set of optimal transmission parameters for a single link. Thus, Cousins fails to disclose or suggest fails to disclose or suggest "notifying neighbor nodes in the network of the mutually-agreed upon optimal bandwidth allocation when reallocation is needed, wherein the neighbor nodes each modify their bandwidth allocation based on the notification," as recited in claim 1.

Furthermore, Cousins focuses on a determination of a set of optimal transmission parameters for a single link, and fails to disclose or suggest at least one flow allocation for which a schedule exists that can realize the at least one flow allocation by taking into account flows in the ad hoc network. Therefore, Cousins also fails to disclose or suggest "wherein the at least one guaranteed feasible flow allocation comprises at least one flow allocation for which a schedule exists that can realize the at least one flow allocation by

taking into account flows in the ad hoc network," as recited in claim 1.

Appellants further submit that Fenton does not cure the deficiencies of Hammel and Cousins. Fenton describes a Time Duplex Multiplex Access ("TDMA") slot assignment method in connection with simplex radios operating in self regulating ad hoc configurations. Each radio is assigned its own broadcast slot in a channel with which it can allocate itself channel resources and inform its neighbors. A radio allocates itself channel resources by assigning itself specific slots. Fenton further describes that individual radios keep track of which slots are allocated to other radios, so that when a given radio needs to transmit packet data it can allocate itself unused slots on a given channel, and not collide with other transmissions (see Fenton at paragraph [0008]).

Appellants respectfully submit that Fenton merely describes that each radio can allocate unused slots of a frame to itself for communication, and can inform neighboring radios of the allocation using a broadcast slot assigned to the radio. Fenton does not disclose that a radio notifies neighboring radios of a mutually-agreed upon optimal bandwidth allocation because Fenton fails to describe any negotiation that occurs between two or more radios. Instead, when a radio needs additional channel resources, the radio determines the presence of any unused slots and allocates the unused slots to itself. Thus, no optimal bandwidth allocation is agreed upon between the radios described in Fenton. Furthermore, Fenton fails to disclose that a neighboring radio modifies its bandwidth allocation based upon a notification, In other words, Fenton fails to disclose or suggest that when a radio allocate additional slots to itself that the neighboring radios modify their own slot allocations based upon a notification that the first radio has allocated additional slots to itself. Instead, only when a radio needs additional

channel resources, does a radio determine which slots are used by neighboring radios, and which slots are unused. Therefore, Fenton fails to disclose or suggest “notifying neighbor nodes in the network of the mutually-agreed upon optimal bandwidth allocation when reallocation is needed, wherein the neighbor nodes each modify their bandwidth allocation based on the notification,” as recited in claim 1.

In addition, similar to Hammel, the slot allocation program of Fenton does not provide a flow allocation for which a schedule exists that can realize the at least one flow allocation by taking into account flows in the ad hoc network because a “flow” cannot reasonably be considered to be analogous to a “slot.” As previously described, a flow is a logical entity that does not depend on whether a system is slotted or not, while a slot is particular to a physical layer realization. Thus, a flow can exist in a slotted system, but can also exist in a non-slotted system, and in a slotted system, a slot can carry one or more flows. Thus, the consideration of whether a slot has previously been allocated is not analogous to taking into account a flow in a network when establishing a flow allocation. Therefore, Fenton also fails to disclose or suggest “wherein the at least one guaranteed feasible flow allocation comprises at least one flow allocation for which a schedule exists that can realize the at least one flow allocation by taking into account flows in the ad hoc network,” as recited in claim 1.

Furthermore, even assuming *arguendo* that the combination of Hammel, Cousins, and Fenton disclosed all the limitations of claim 1 (not admitted), Appellants submit that the Final Office Action has failed to provide a sufficient rationale for combining the references of Hammel, Cousins, and Fenton. While the Final Office Action alleged that it would have been obvious to one of ordinary skill in the art at the time of the invention to

modify the system of Hammel to use the features of Cousins in order to provide the communication with optimized bandwidth and transfer conditions, and to use the features of Fenton in order to avoid colliding with another transmission, these generic rationales do not address why one of ordinary skill in the art would be motivated to modify a process of advertising a cancellation of a slot allocation to all neighboring nodes (where no negotiation takes place) described in Hammel, to include a negotiation process to determine a best use of available bandwidth (where no notification takes place) described in Cousins, and to include a slot assignment method described in Cousins (where Hammel already addresses assigning slots).

Accordingly, Appellants respectfully submit that the Final Office Action has failed to establish a prima facie case of obviousness, as claim 1 would not have been obvious to one of ordinary skill of the art, at the time the invention was made, in light of the cited references of Hammel, Cousins, and Fenton. Thus, it is respectfully requested that this rejection be reversed and the claim allowed.

ii) Claim 2

Claim 2 is dependent on claim 1, and recites further limitations. Thus, claim 2 is patentable at least for the reasons claim 1 is patentable, and further, because it recites additional limitations.

Specifically, claim 2 also recites "re-performing the initiating, determining, communicating, notifying, and adopting steps at a later point in time." The Final Office Action took the position that col. 6, lines 19-26 describes that a network initialization process may continue, that the network initialization process includes the initiating,

determining, communicating, and adopting steps, that Hammel discloses the notifying step, and that the notifying step of Hammel could be incorporated into the initialization process described in Cousins (see Final Office Action at page 9). However, the cited portion of Cousins merely discloses during a period of idleness, a network initiation process may continue in the form of an <u>ongoing calibration</u> to gather measurements and statistics to optimize communication over the link (see Cousins at col. 6, lines 19-26). Thus, even assuming *arguendo* that the network initialization process of Cousins, disclosed the initiating, determining, communication, and adopting steps, that Hammel disclosed the notifying step, and that the notifying step of Hammel could be incorporated into the initialization process described in Cousins (none of which is admitted by Appellants), the cited portion of Cousins fails to disclose re-performing the network initialization process. Instead, the cited portion merely discloses <u>continuing the calibration</u> associated with the network initialization process. Thus, Cousins fails to disclose, or suggest, "re-performing the initiating, determining, communicating, notifying, and adopting steps at a later point in time," as recited in claim 2. Furthermore, the Final Office Action has failed to establish that Hammel and Fenton cure the deficiency of Cousins.

Accordingly, Appellants respectfully submit that the Final Office Action has failed to establish a prima facie case of obviousness, as claim 2 would not have been obvious to one of ordinary skill of the art, at the time the invention was made, in light of the cited references of Hammel, Cousins, and Fenton. Thus, it is respectfully requested that this rejection be reversed and the claim allowed.

iii) Claim 4

Claim 4 is dependent on claim 1, and recites further limitations. Thus, claim 4 is patentable at least for the reasons claim 1 is patentable, and further, because it recites additional limitations. Accordingly, Appellants respectfully submit that the Final Office Action has failed to establish a prima facie case of obviousness, as claim 4 would not have been obvious to one of ordinary skill of the art, at the time the invention was made, in light of the cited references of Hammel, Cousins, and Fenton. Thus, it is respectfully requested that this rejection be reversed and the claim allowed.

iv) Claim 5

Claim 5 is dependent on claim 1, and recites further limitations. Thus, claim 5 is patentable at least for the reasons claim 1 is patentable, and further, because it recites additional limitations. Accordingly, Appellants respectfully submit that the Final Office Action has failed to establish a prima facie case of obviousness, as claim 5 would not have been obvious to one of ordinary skill of the art, at the time the invention was made, in light of the cited references of Hammel, Cousins, and Fenton. Thus, it is respectfully requested that this rejection be reversed and the claim allowed.

v) Claim 6

Claim 6 recites a network device configured to allocate bandwidth in an ad hoc, wireless network configured to support at least one guaranteed feasible flow allocation. The device includes a first communication unit configured to initiate a communication between the device and a node in the network that, together, are endpoints of a link in the

network, the communication being related to possible bandwidth allocation adjustment of a flow sharing the link, and a first processing unit configured to determine a first new bandwidth allocation that approaches a first optimization condition for the flow, wherein the first processing unit is operably connected to the first communication unit. The device further includes a second communication unit configured to communicate with the node to determine a mutually-agreed upon optimal bandwidth allocation for the flow, wherein the second communication unit is operably connected to the first communication unit, and a third communication unit configured to notify neighbor nodes in the network of the mutually-agreed upon optimal bandwidth allocation when reallocation is needed, wherein the neighbor nodes each modify their bandwidth allocation based on the notification, and wherein the third communication unit is operably connected to the first communication unit. The device further includes a second processing unit configured to adopt the mutually-agreed upon optimal allocation for the flow when reallocation is needed, wherein the second processing unit is operably connected to the first communication unit. The at least one guaranteed feasible flow allocation includes at least one flow allocation for which a schedule exists that can realize the at least one flow allocation by taking into account flows in the ad hoc network.

While each of the claims of the present application have their own scope, Appellants respectfully submit that Hammel, Cousins, and Fenton, whether considered individually or in combination, fail to disclose or suggest, at least, "a third communication unit configured to notify neighbor nodes in the network of the mutually-agreed upon optimal bandwidth allocation when reallocation is needed, wherein the neighbor nodes each modify their bandwidth allocation based on the notification," and "wherein the at

least one guaranteed feasible flow allocation comprises at least one flow allocation for which a schedule exists that can realize the at least one flow allocation by taking into account flows in the ad hoc network," as recited in claim 6, based on reasoning similar to the reasoning discussed in Section VII, A, i. Furthermore, even assuming *arguendo* that the combination of Hammel, Cousins, and Fenton disclosed all the limitations of claim 6 (not admitted), Appellants submit that the Final Office Action has failed to provide a sufficient rationale for combining the references of Hammel, Cousins, and Fenton based on reasoning similar to the reasoning discussed in Section VII, A, i.

Accordingly, Appellants respectfully submit that the Final Office Action has failed to establish a prima facie case of obviousness, as claim 6 would not have been obvious to one of ordinary skill of the art, at the time the invention was made, in light of the cited references of Hammel, Cousins, and Fenton. Thus, it is respectfully requested that this rejection be reversed and the claim allowed.

vi) Claim 7

Claim 7 recites a computer program embodied on a computer readable medium to allocate bandwidth in an ad hoc, wireless network configured to support at least one guaranteed feasible flow allocation. The computer program is configured to control a processor to perform a first sub-routine for initiating a communication between the first node and a second node in the network that, together, are endpoints of a link, the communication being related to possible bandwidth allocation adjustment of a flow sharing the link, and a second sub-routine for determining, in the first node, a first new bandwidth allocation that approaches a first optimization condition for the flow. The

computer program is further configured to control the processor to perform a third sub-routine for communicating with the second node to determine a mutually-agreed upon optimal bandwidth allocation for the flow, and a fourth sub-routine for notifying neighbor nodes in the network of the mutually-agreed upon optimal bandwidth allocation when reallocation is needed, where the neighbor nodes each modify their bandwidth allocation based on the notification. The computer program is further configured to control a processor to perform a fifth sub-routine for adopting the mutually-agreed upon optimal allocation for the flow when reallocation is needed. The at least one guaranteed feasible flow allocation includes at least one flow allocation for which a schedule exists that can realize the at least one flow allocation by taking into account flows in the ad hoc network.

While each of the claims of the present application have their own scope, Appellants respectfully submit that Hammel, Cousins, and Fenton, whether considered individually or in combination, fail to disclose, or suggest, at least, "a fourth sub-routine for notifying neighbor nodes in the network of the mutually-agreed upon optimal bandwidth allocation when reallocation is needed, wherein the neighbor nodes each modify their bandwidth allocation based on the notification," and "wherein the at least one guaranteed feasible flow allocation comprises at least one flow allocation for which a schedule exists that can realize the at least one flow allocation by taking into account flows in the ad hoc network," as recited in claim 7, based on reasoning similar to the reasoning discussed in Section VII, A, i. Furthermore, even assuming *arguendo* that the combination of Hammel, Cousins, and Fenton disclosed all the limitations of claim 7 (not admitted), Appellants submit that the Final Office Action has failed to provide a sufficient rationale for combining

the references of Hammel, Cousins, and Fenton based on reasoning similar to the reasoning discussed in Section VII, A, i.

Accordingly, Appellants respectfully submit that the Final Office Action has failed to establish a prima facie case of obviousness, as claim 7 would not have been obvious to one of ordinary skill of the art, at the time the invention was made, in light of the cited references of Hammel, Cousins, and Fenton. Thus, it is respectfully requested that this rejection be reversed and the claim allowed.

vii) Claim 8

Claim 8 recites a network device configured to allocate bandwidth in an ad hoc, wireless network configured to support at least one guaranteed feasible flow allocation. The device includes initiation means for initiating a communication between the first node and a second node in the network that, together, are endpoints of a link, the communication being related to possible bandwidth allocation adjustment of a flow sharing the link, and determination means for determining, in the first node, a first new bandwidth allocation that approaches a first optimization condition for the flow. The device further includes determination means for communicating with the second node to determine a mutually-agreed upon optimal bandwidth allocation for the flow, and notification means for notifying neighbor nodes in the network of the mutually-agreed upon optimal bandwidth allocation when reallocation is needed, where the neighbor nodes each modify their bandwidth allocation based on the notification. The device further includes adoption means for adopting the mutually-agreed upon optimal allocation for the flow when reallocation is needed. The at least one guaranteed feasible flow

allocation includes at least one flow allocation for which a schedule exists that can realize the at least one flow allocation by taking into account flows in the ad hoc network.

While each of the claims of the present application have their own scope, Appellants respectfully submit that Hammel, Cousins, and Fenton, whether considered individually or in combination, fail to disclose, or suggest, at least, "notification means for notifying neighbor nodes in the network of the mutually-agreed upon optimal bandwidth allocation when reallocation is needed, wherein the neighbor nodes each modify their bandwidth allocation based on the notification," and "wherein the at least one guaranteed feasible flow allocation comprises at least one flow allocation for which a schedule exists that can realize the at least one flow allocation by taking into account flows in the ad hoc network," as recited in claim 8, based on reasoning similar to the reasoning discussed in Section VII, A, i. Furthermore, even assuming *arguendo* that the combination of Hammel, Cousins, and Fenton disclosed all the limitations of claim 8 (not admitted), Appellants submit that the Final Office Action has failed to provide a sufficient rationale for combining the references of Hammel, Cousins, and Fenton based on reasoning similar to the reasoning discussed in Section VII, A, i.

Accordingly, Appellants respectfully submit that the Final Office Action has failed to establish a prima facie case of obviousness, as claim 8 would not have been obvious to one of ordinary skill of the art, at the time the invention was made, in light of the cited references of Hammel, Cousins, and Fenton. Thus, it is respectfully requested that this rejection be reversed and the claim allowed.

B. Claim 3 is not obvious in view of Hammel, Cousins, Fenton, and Counterman

In the Final Office Action, claim 3 was rejected under 35 U.S.C. § 103(a) as being unpatentable over Hammel, Cousins, Fenton, and Counterman. Appellants submit that claim 3 recites subject matter that is not obvious in light of Hammel, Cousins, Fenton, and Counterman, and such, the Board's reversal of the rejection is respectfully requested.

Claim 3 is dependent on claim 1, and recites further limitations. As the Final Office Action has failed to establish that Counterman cures the deficiencies of Hammel, Cousins, and Fenton, described above, claim 3 is patentable at least for the reasons claim 1 is patentable.

Furthermore, claim 3 is also patentable because, as will be discussed below in greater detail, Hammel, Cousins, Fenton, and Counterman, whether considered individually or in combination, fail to disclose, or suggest, at least, "determining, in the first node, the first new bandwidth allocation that approaches at least one of a Max Min Fair condition and a Quality of Service guarantee condition," as recited in claim 3.

Hammel, Cousins, and Fenton are described above. Counterman generally describes a method and apparatus for a communications system that prioritizes packets that are transmitted over a digital communication channel utilizing at least one error-correcting transmission path associated with a Quality of Service ("QoS") objective. The QoS objective is used to select the appropriate transmission path (that may include forward error coding, scrambling, and interleaving) that satisfies the relevant metrics of the desired level of service quality such as packet latency, variation of the packet latency, information throughput, and packet error rate ("PER"). The communications system selects a transmission path that is associated with QoS objectives best matched to the

QoS objectives as required by the originating application (see Counterman at Abstract).

The Final Office Action correctly concluded that the combination of Hammel, Cousins, and Fenton fails to disclose or suggest, “determining, in a first node, a first new bandwidth allocation that approaches at least one of a Max Min Fair condition and a Quality of Service guarantee condition,” as recited in claim 3. The Final Office Action then cited Counterman as allegedly curing the deficiencies of Hammel, Cousins, and Fenton (see Final Office Action at page 12). Appellants respectfully submit that Counterman fails to disclose or suggest the aforementioned limitation of claim 3. Counterman merely discloses that a communications system manages, monitors, and prioritizes packets and allocates bandwidth with a packet network in order to satisfy the QoS objectives associated with the originating application (see Counterman at col. 1, lines 63-66). Appellants respectfully submit that this disclosure is merely a statement of an intended objective and does not enable one of ordinary skill in the art how to determine if a new bandwidth allocation approaches a Quality of Service guarantee condition. In other words, one of ordinary skill in the art would readily understand that are several systems for which one can allocate bandwidth to realize a QoS guarantee condition, but a method for achieving the condition differs from system to system. Furthermore, Applicants respectfully submit that embodiments of the invention, may not only realize QoS objectively, but also may realize fairness objectives in wireless ad hoc networks, a concept not disclosed in Counterman.

Accordingly, Appellants respectfully submit that the Final Office Action has failed to establish a prima facie case of obviousness, as claim 3 would not have been obvious to one of ordinary skill of the art, at the time the invention was made, in light of the cited

references of Hammel, Cousins, Fenton, and Counterman. Thus, it is respectfully requested that this rejection be reversed and the claim allowed.

For all of the above noted reasons, it is strongly contended that certain clear differences exist between the present invention as claimed in claims 1-8 and the prior art relied upon by the Examiner. It is further contended that these differences are more than sufficient that the present invention would not have been obvious to a person having ordinary skill in the art at the time the invention was made.

This final rejection being in error, therefore, it is respectfully requested that this honorable Board of Patent Appeals and Interferences reverse the Examiner's decision in this case and indicate the allowability of application claims 1-8.

In the event that this paper is not being timely filed, the applicants respectfully petition for an appropriate extension of time. Any fees for such an extension together with any additional fees which may be due with respect to this paper may be charged to Counsel's Deposit Account 50-2222.

Respectfully submitted,

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Encls: Appendix 1 - Claims on Appeal
Appendix 2 - Evidence
Appendix 3 - Related Proceedings

APPENDIX 1

CLAIMS ON APPEAL

1. (Previously Presented) A method of allocating bandwidth in a first node that is operable in an ad hoc, wireless network configured to support at least one guaranteed feasible flow allocation, the method comprising the steps of:

initiating a communication between the first node and a second node in the network that, together, are endpoints of a link, the communication being related to possible bandwidth allocation adjustment of a flow sharing the link;

determining, in the first node, a first new bandwidth allocation that approaches a first optimization condition for the flow;

communicating with the second node to determine a mutually-agreed upon optimal bandwidth allocation for the flow;

notifying neighbor nodes in the network of the mutually-agreed upon optimal bandwidth allocation when reallocation is needed, wherein the neighbor nodes each modify their bandwidth allocation based on the notification; and

adopting the mutually-agreed upon optimal allocation for the flow when reallocation is needed,

wherein the at least one guaranteed feasible flow allocation comprises at least one flow allocation for which a schedule exists that can realize the at least one flow allocation by taking into account flows in the ad hoc network.

2. (Original) The method of claim 1, further comprising the step of:

re-performing the initiating, determining, communicating, notifying, and adopting

steps at a later point in time.

3. (Previously Presented) The method of claim 1 wherein the determining step comprises determining, in the first node, the first new bandwidth allocation that approaches at least one of a Max Min Fair condition and a Quality of Service guarantee condition.

4. (Original) The method of claim 1, wherein the initiating step comprises initiating a communication between the first node and the second node in a slotted, ad hoc, wireless network.

5. (Original) The method of claim 1, wherein the initiating step comprises initiating a communication between the first node and the second node in a network on which a Time Division Multiple Access (TDMA) schedule is implemented.

6. (Previously Presented) A network device configured to allocate bandwidth in an ad hoc, wireless network configured to support at least one guaranteed feasible flow allocation, the device comprising:

a first communication unit configured to initiate a communication between the device and a node in the network that, together, are endpoints of a link in the network, the communication being related to possible bandwidth allocation adjustment of a flow sharing the link;

a first processing unit configured to determine a first new bandwidth allocation that approaches a first optimization condition for the flow, wherein the first processing unit is

operably connected to the first communication unit;

a second communication unit configured to communicate with the node to determine a mutually-agreed upon optimal bandwidth allocation for the flow, wherein the second communication unit is operably connected to the first communication unit;

a third communication unit configured to notify neighbor nodes in the network of the mutually-agreed upon optimal bandwidth allocation when reallocation is needed, wherein the neighbor nodes each modify their bandwidth allocation based on the notification, and wherein the third communication unit is operably connected to the first communication unit; and

a second processing unit configured to adopt the mutually-agreed upon optimal allocation for the flow when reallocation is needed, wherein the second processing unit is operably connected to the first communication unit,

wherein the at least one guaranteed feasible flow allocation comprises at least one flow allocation for which a schedule exists that can realize the at least one flow allocation by taking into account flows in the ad hoc network.

7. (Previously Presented) A computer readable medium encoded with a computer program to allocate bandwidth in an ad hoc, wireless network configured to support at least one guaranteed feasible flow allocation, which, when executed, is configured to control a processor to perform:

a first sub-routine for initiating a communication between the first node and a second node in the network that, together, are endpoints of a link, the communication being related to possible bandwidth allocation adjustment of a flow sharing the link;

a second sub-routine for determining, in the first node, a first new bandwidth allocation that approaches a first optimization condition for the flow;

a third sub-routine for communicating with the second node to determine a mutually-agreed upon optimal bandwidth allocation for the flow;

a fourth sub-routine for notifying neighbor nodes in the network of the mutually-agreed upon optimal bandwidth allocation when reallocation is needed, wherein the neighbor nodes each modify their bandwidth allocation based on the notification; and

a fifth sub-routine for adopting the mutually-agreed upon optimal allocation for the flow when reallocation is needed,

wherein the at least one guaranteed feasible flow allocation comprises at least one flow allocation for which a schedule exists that can realize the at least one flow allocation by taking into account flows in the ad hoc network.

8. (Previously Presented) A network device configured to allocate bandwidth in an ad hoc, wireless network configured to support at least one guaranteed feasible flow allocation, the device comprising:

initiation means for initiating a communication between the first node and a second node in the network that, together, are endpoints of a link, the communication being related to possible bandwidth allocation adjustment of a flow sharing the link;

determination means for determining, in the first node, a first new bandwidth allocation that approaches a first optimization condition for the flow;

determination means for communicating with the second node to determine a mutually-agreed upon optimal bandwidth allocation for the flow;

notification means for notifying neighbor nodes in the network of the mutually-agreed upon optimal bandwidth allocation when reallocation is needed, wherein the neighbor nodes each modify their bandwidth allocation based on the notification; and

adoption means for adopting the mutually-agreed upon optimal allocation for the flow when reallocation is needed,

wherein the at least one guaranteed feasible flow allocation comprises at least one flow allocation for which a schedule exists that can realize the at least one flow allocation by taking into account flows in the ad hoc network.

APPENDIX 2

EVIDENCE APPENDIX

No evidence under section 37 C.F.R. 1.130, 1.131, or 1.132 has been entered or will be relied upon by Appellants in this appeal.

APPENDIX 3

RELATED PROCEEDINGS APPENDIX

No decisions of the Board or of any court have been identified under 37 C.F.R. §41.37(c)(1)(ii).